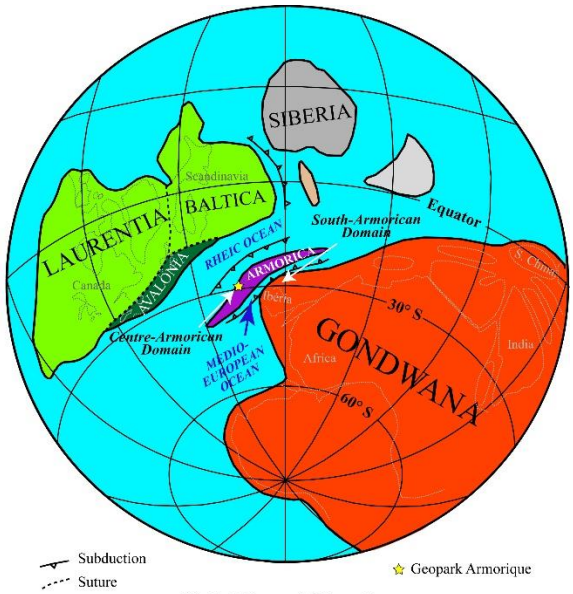
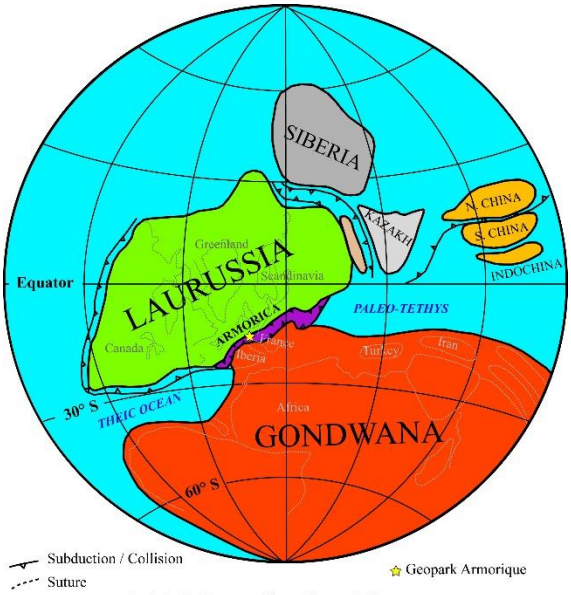
Geopark Armorique

An ancient sea in the heart of a mountain range

Simplified geological history

The Armorican massif represents the westernmost part of the ancient Hercynian mountain range which forms the old basement of Western Europe, as far east as the Russian platform. The geological history of the Hercynian chain results from the spatial and temporal evolution of three major continental plates, the Gondwana (south), Armorica (central) and Laurussia (north) ones, which collided near 340-300 million years after the sinking of two earlier oceanic domains into the mantle (subduction): Rheic and mid-European oceans (Figs 1A, B).





Modified from Matte (2001)

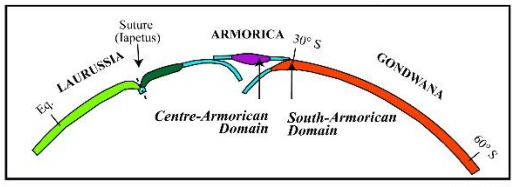


Fig. 1A

Modified from Matte (2001)

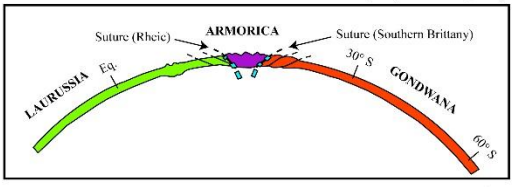


Fig. 1B

Most part of this history is recorded in the Armorican geology, where the relics of the ancient oceanic domains are preserved in the form of continental scars or « suture zones » in the south and the north of the Armorican Massif (Fig. 2A).

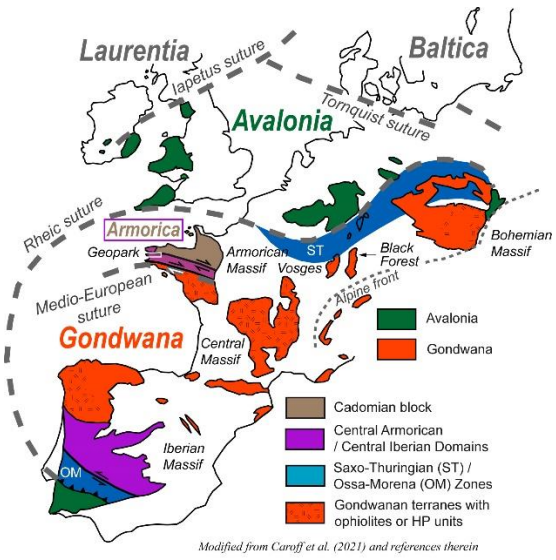


Fig. 2A

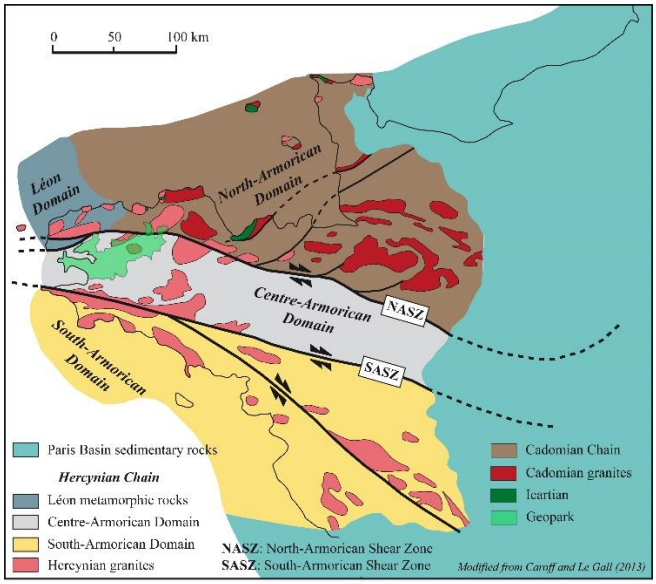


Fig. 2B

The structural arrangement of the Herynian belt in Armorica is dominated by two nearly EW-trending major discontinuities, places for horizontal movement between crustal blocks for several kilometres: the North- and South-Armorican shear zones (NASZ and SASZ). These vertical structures result in the partitioning of the massif into three domains (Fig. 2B) : the North-Armorican Domain (NAD), which contains the oldest geological relics in France (*c.* 2 billion years), involved in the oldest W-European mountain range, the Cadomian one (610-540 million years); the Centre-Armorican Domain (CAD), mostly of sedimentary and granitic origins and to which is juxtaposed the Leon area; and lastly, the South-Armorican Domain (SAD), mainly composed of metamorphic and granitic rocks. From a paleogeographic point of view, the Centre- and North-Armorican Domains belong to the Armorica paleo-plate whereas the South-Armorican Domain is part of the Gondwana paleo-plate (Figs 1A, B; 2A).

Because of its location in the Centre-Armorican Domain (Fig. 2B), the Armorique Geopark territory is typified by a great variety of rocky formations, displaying a wide range of ages, that allows to trace accurately the geological evolution during a nearly 200 million years-lasted period, in the time-range 500-300 million years.

A long marine sedimentary history

The first step of this long history is recorded in the km's thick pile of sedimentary formations exceptionally exposed in the western sector of the Geopark, more especially along coastal cliffs in the Crozon Peninsula and in the Brest Bay. Thanks to their well-preserved paleontological and sedimentary archives, one can define how marine organisms and climatic patterns have evolved through time, over a continuous period of 150 million years. Indeed, spectacular climatic changes are evidenced, with extreme fluctuations from near-glacial

(Veryac'h Ordovician profile in Crozon) to temperate/tropical conditions (Devonian coral reefs of the Armorique Headland in Plougastel-Daoulas). In addition, a one-off event is to be highlighted, namely the c. 450 million years-old subaqueous volcanism expressed along the Raguenez and Lostmarc'h coastal cliffs in the Crozon peninsula and similarly recorded elsewhere in Europe.

The hercynian compression

Later on, in Early Carboniferous times (345-330 million years), the northern domains (NAD, Leon and CAD) experienced an extensional event which resulted in the development of fault-bounded basins (Châteaulin and Laval) in the Centre-Armorican Domain. The existence of these inferred steeply-dipping bounding faults helped the ascent of mantle-derived magmas, such as those of the dolerites in the Brest Bay and basaltic lavas in the Châteaulin basin. As early as 330 million years, the CAD sedimentary/basinal area underwent a dramatic upheaval, as being progressively involved in Hercynian orogenic processes, expressed through a regional-scale fault/fold system. In western Armorica, Hercynian compressional structures operated coevally with an important mantle-derived (Brest Bay kersantites) and then crust-derived (Commana and Huelgoat granites) magmatism.

A recent study of the kersantites rocks from the Brest Bay has permit to apply a new plate collisional model to the Armorican Massif. The early emplacement of the kersantite swarm (330-310 million years-old) implies an important mantle upwelling process, as high as 80 km deep at an early stage of the Armorica-Laurussia collision event. That likely resulted from either the steepening of the plunging lithospheric plate (Fig. 3, Model A), or the detachment and deepening of the lower part of the overriding plate (Fig. 3, Model B).

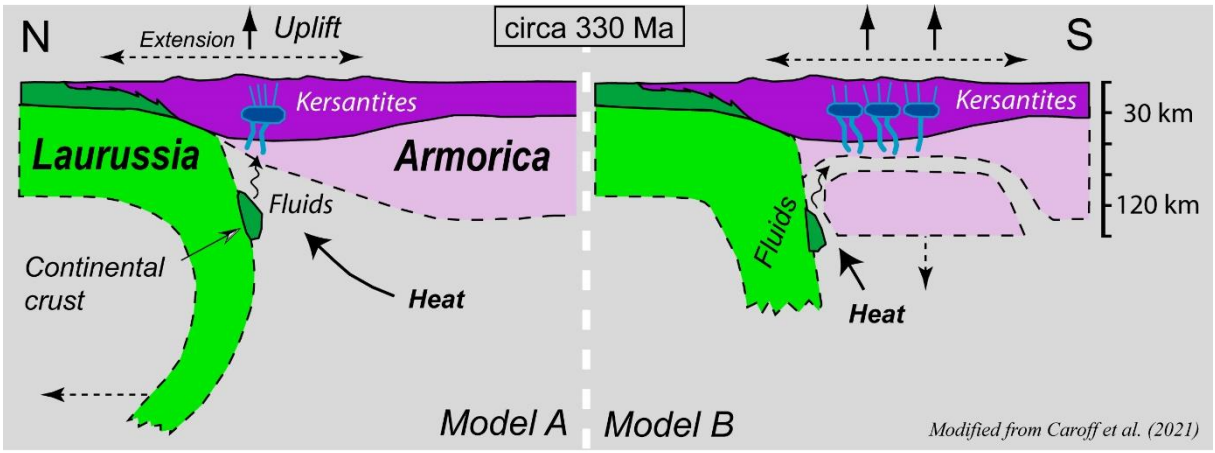


Fig. 3

Erosion and landscape shaping

About 310 million years ago, the third step of the history started with the progressive erosion of the Hercynian mountainous reliefs – which could have reached several hundred thousand metre high to the maximum of the compression, such as the present-day Alps or Himalaya mountain ranges –, leading ultimately to the contemporary landscape morphologies. This long and nearly uneventful period was only disturbed at around 200 million years by the intrusion of dolerites (intrusive equivalents of the basaltic lavas) that are part of a worldwide magmatic swarm emplaced along the future Atlantic borders (not yet opened at that time). Spectacular evidence for this magmatic event exists in the Crozon Peninsula where the Mort Anglaise site represents the unique evidence of such circa-Atlantic magmatism in France. It also corresponds to the youngest magmatic event in the Armorican Massif. The final touch is brought by the Human who built, as far back as Upper Paleolithic times, emblematic monuments from quarried stones, such as the famous parish enclosures chiefly built with kersantite rocks as well as with the associated microgranodiorite, the so-called Le Roz stone (Logonna-Daoulas quarry).

Références

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